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# Bio-diversity of Mosquitoes in Sub-Urban Area, Thiruthangal, Virudhunagar District, Tamil Nadu, India

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**Abstract:** A survey was conducted to investigate the mosquito diversity in sub-urban area of Thiruthangal, Virudhunagar District, Tamil Nadu, India. This village is located near the highly polluted and sewage water bodies and associated with surrounding agriculture fields. The study was undertaken for six months from August 2008 to January 2009. Twelve sites have been chosen on the basis of the location and available breeding habitats for the mosquitoes. The collection of adult mosquitoes was made by using Human biting method. There were 10 species of mosquito collected belonging to the 4 genera (*Aedes, Anopheles, Armigeres* and *Culex*). Among these, *Aedes* and *Culex* was more diversity in all around the study sites. The pattern of occurrence, *Culex quinguefasciatus* and *Culex pseudovishnui* was moderate and followed by 5 species are infrequent. Remaining 3 (*Culex infula, Anopheles subpictus and Anopheles hyrcanus* group) species are sporadic in pattern.

**Key words:** Mosquito · Agriculture · Genera · Pattern of Occurrence

## INTRODUCTION

Mosquito larval habitats are the locations where many important life-cycle processes take place: oviposition, larval development, adult emergence, resting, swarming and mating [1]. Effective control of malaria through vector management requires information on the distribution and abundance of vectors in the targeted areas. Mosquito larval control is a potentially important target in malaria vector control. Source reduction through modification of larval habitats was the key to malaria eradication efforts in the United States, Italy and Israel [2].

Chilika is the largest brackish water lake of India and it is connected to the Bay of Bengal by a narrow 32 km long channel south to the mouth of Mahanadi River in Orissa, India. The area of the lake varies from the 1165 $km^2$ during the monsoon to 906 $km^2$ in the dry season, respectively. The highly productive lake ecosystem with its rich fishery resources sustains the livelihood of more than 0.15 million fishermen inhabiting in and around the lake. The mouth connecting the channel to the sea is close to the north eastern end of the lake. It lies in the districts of Puri, Khurda and Ganjam of the Orissa state. The villages near this area have a typical climate with an average annual maximum temperature of 39ºC and minimum of 14ºC. The lake and its water channels harbor a large number of faunal groups including mosquitoes. The coastal wetlands have 8 culicine species and 14 anopheline species of mosquitoes [3]. The aim of this study was to determine the total range of mosquito species diversity in terms of species richness and species-rich sites in both wet and dry area which will serve as an important tool in disease forecasting and monitoring them.

## MATERIALS AND METHODS

**Study Area:** Thiruthangal is an industrialized area and also well known for fire works (Five in number) and match works (Five in number), has been selected for the study. It is located in Sivakasi Taluk, Virudhunagar district. It has rare cultivated area, stagnant water bodies and highly polluted sewage water and other mosquitogenic conditions. The study area also consists of varying number of cattle and other animals are considered as the host for mosquitoes. Twelve sites have been chosen on the basis of the location of and available breeding habitats for the mosquitoes.

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**Study Period:** The study was conducted in Thiruthangal and samples were obtained. This village is located near the highly polluted and sewage water bodies and associated with surrounding agriculture fields. The study was under taken for six months from August 2008 to January 2009. The diversity of the various species of mosquitoes in Thiruthangal municipality have been studied using three types of collection methods, i.e. twelve hours man landing collections, periodic resting adult collections and collection of immature stages from the breeding habitats. Systematic twelve hours human-bait collections were made every week from August 2008 to January 2009 in all the sites of the village. The collection of adult mosquitoes were made by using Human Biting method [4].

**Data Analysis:** Mosquito sampling resulted in enormous number of individuals, which was used to asses the diversity index and behavioral aspects including pattern of occurrence.

**Biodiversity Index:** Mosquitoes diversity was evaluated using species richness index or alpha diversity [5] to assess the degree of biodiversity by following the formula.

$$\alpha = 1-\Sigma(x1/t)^2 (x2/t)^2 (x3/t)^2 \ldots..(Xn/t)^2$$

where

$\alpha$ = Species richness index
t = Total number of mosquitoes of all species
x = Number of each species

**Pattern of Occurrence:** Knowledge on the pattern of occurrence of mosquitoes reveals the dimension of spatial distribution and the rate of existence in the selective study sites. Based on the biting, the pattern of occurrence of the mosquitoes was classified into five categories. This pattern of mosquitoes was analyzed by applying the method adopted [6].

The following formula was used,

$$C=\frac{n}{N}X100$$

where

C = Pattern of occurrence
n = Number of sites positive for the occurrence of mosquitoes
N = Total number of sites studied
If C is = 0-20% the distribution pattern of occurrence is sporadic
= 20.1-40% the distribution pattern of occurrence is in frequent
= 40.1-60% the distribution pattern of occurrence is moderate
= 60.1-80% the distribution pattern of occurrence is frequent and
= 80.1-100% the distribution pattern of occurrence is constant.

## RESULTS AND DISCUSSIONS

During the study period totally 10 species of mosquitoes collected belonging to four genera *Aedes, Anopheles, Armigeres* and *Culex.* These comprised of four species of *Culex*, three species of *Aedes*, two species of *Anopheles* and one species of *Armigeres* (Table 1). Similar observation was reported where the diversity was positively correlated with existence of artificial irrigation system and simultaneous plantation of paddy and other crops also (Burroni *et al*., 2007 and Klinkenberg, *et al.,* 2003). Occurrence of adult mosquitoes was recorded in the five study region (Table 2). Most of *An. gambiae* larvae were collected in temporary pools and puddles. *Anopheles* mosquitoes have been shown to frequently occur in small temporary pools, such as pits, tyre tracks and animal footprints [8]. Because small and sunlit habitats have higher water temperatures, mosquito larval-pupal developmental time may be shortened if the warmer habitat produces more food resources.

Table 1: Diversity of mosquito species recorded in the study area during the study period (Aug 2008- Jan 2009)

| S.No | Name of the species |
|---|---|
| 1 | *Aedes* (*Stegomyia*) *aegypti* (Linnaeus) |
| 2 | *Aedes* (*Stegomyia*) *albopictus* Skuse |
| 3 | *Aedes* (*Aedimorphus*) *vittatus* (Bigot) |
| 4 | *Anopheles* (*Cellia*) *hyrcanus* group |
| 5 | *Anopheles* (*Cellia*) *subpictus* Grassi |
| 6 | *Armigeres* (*Armigeres*) *subalbatus* (Coquillett) |
| 7 | *Culex* (*Culex*) *infula* Theobald |
| 8 | *Culex* (*Culex*) *pseudovishnui* Colless |
| 9 | *Culex* (*Culex*) *quinquefasciatus* Say |
| 10 | *Culex* (*Culex*) *tritaeniorhynchus* Giles |

Table 2: Occurrence of adult mosquito species in various regions of the study area during the study period (Aug 2008- Jan 2009)

| | Name of the species | Central region | Western region | Northern region | Eastern region | Southern region | Total |
|---|---|---|---|---|---|---|---|
| *Ae. aegypti* | + | + | + | + | + | 5 | |
| *Ae. albopictus* | + | + | + | + | + | 5 | |
| *Ae. vittatus* | + | - | + | + | + | 4 | |
| *An. hyrcanus* group | | - | - | - | + | - | 1 |
| *An. subpictus* | - | - | - | - | - | 1 | |
| *Ar. subalbatus* | + | + | + | + | + | 5 | |
| *Cx. infula* | - | - | + | - | + | 2 | |
| *Cx. pseudovishnui* | + | + | + | + | + | 5 | |
| *Cx. quinquefasciatus* | + | + | + | + | + | 2 | |
| *Cx.tritaeniorhynchus* | + | + | + | + | + | 2 | |
| Total | 888 | 8 88 7 | 6 | 8 | 9 | 8 | 38 |

Table 3: Season wise diversity of mosquitoes recorded in study area during study period (Aug 2008- Jan 2009)

| | Seasons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Moderate rainy Season | | | Acute rainy season | | | Winter season | | |
| Mosquito Species | Aug'08 | Sep'08 | Total | Oct'08 | Nov'08 | Total | Dec'08 | Jan'09 | Total |
| *Aedes aegypti* | 1 | 1 | 2 | 2 | 2 | 4 | 2 | 1 | 3 |
| *Aedes albopictus* | - | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 3 |
| *Aedes vittatus* | - | 3 | 3 | 1 | - | 1 | 1 | 1 | 2 |
| *Anopheles hyrcanus* group | - | - | - | - | | - | 1 | - | 1 |
| *Anopheles subpictus* | - | - | - | - | 1 | 1 | 1 | - | 1 |
| *Armigere subalbatus* | - | - | - | 1 | 2 | 3 | 2 | 1 | 3 |
| *Culex infula* | 1 | 1 | 2 | 1 | - | - | - | - | - |
| *Culex pseudovishnui* | 2 | 3 | 5 | 2 | 1 | 3 | 1 | 1 | 2 |
| *Culex quinquefasciatus* | 2 | 3 | 5 | 2 | 2 | 4 | 2 | 1 | 3 |
| *Culex tritaeniorhynchus* | - | - | - | 1 | 2 | 3 | 2 | 1 | 3 |
| Occurrence | 6 | 11 | 17 | 10 | 12 | 22 | 14 | 7 | 21 |
| Biodiversity index (α) | 0.72 | 0.79 | 0.78 | 0.81 | 0.86 | 0.86 | 0.88 | 0.90 | 0.88 |

Table 4: Diversity and species richness of mosquito recorded in the study area during the study period (Aug 2008- Jan 2009)

| | Moderate rainy season | Acute rainy season | Winter Season |
|---|---|---|---|
| Name of the species | (Aug 2008- Sep 2008) | (Oct 2008- Nov2008) | (Dec 2008- Jan 2009) |
| *Ae. aegypti* | + | + | + |
| *Ae. albopictus* | + | + | + |
| *Ae. vittatus* | + | + | + |
| *An. hyrcanus* group | - | - | + |
| *An. Subpictus* | - | + | + |
| *Ar. subalbatus* | - | + | + |
| *Cx. Infula* | + | + | - |
| *Cx.pseudovishnui* | + | + | + |
| *Cx.quinquefasciatus* | + | + | + |
| *Cx.tritaeniorhynchus* | - | + | + |
| Total | 6 | 9 | 9 |
| Biodiversity index (α) | 0.78 | 0.86 | 0.88 |

Table 5: The pattern of occurrence of mosquitoes collected in the study area during the study period (Aug 2008- Jan 2009)

| Name of the species | Pattern of occurrence | Percentage of occurrence | Total number of species |
|---|---|---|---|
| *Culex quinquefasciatus* | Moderate | 50.00 | 2 |
| *Culex pseudovishnui* | | 41.67 | |
| *Aedes aegypti* | | 37.50 | |
| *Aedes albopictus* | | 25.00 | |
| *Armigeres subalbatus* | Infrequent | 25.00 | 5 |
| *Aedes vittatus* | | 20.83 | |
| *Culex tritaeniorhynchus* | | 20.83 | |
| *Culex infula* | | 12.50 | |
| *Anopheles subpictus* | Sporadic | 8.30 | 3 |
| *Anopheles hyrcanus group* | | 4.17 | |

Among these study regions, the occurrence of mosquitoes was more in the eastern region (**9**) during the study period Aug 2008- Jan 2009 and followed by the remaining regions Central (**7**), Western (**6**), Northern (**8**) and Southern (**8**). *Anopheles stephensi* breeds in a wide range of both urban and rural habitats throughout its distribution region. In urban areas, this species breeds in all sources of water bodies, such as wells, cisterns, fountains, ornamental ponds and in water pools used for building constructions. Larvae can be collected from ponds, pools, stream margins, catch basins and seepage canals. It is found in water with high salinity, sometimes reaching or even exceeding that of seawater. In rural areas, the breeding places are pools, streambeds, palm irrigation canals, at the margin of streams and rivers, seepages and marshy areas with a gentle water flow [10]. *Anopheles turkhudi* has been collected mainly from the permanent water bodies, which often have vegetation. It breeds in fully sunlit habitats with sandy beds. It has also found from rice-fields, clean and sweet water. Most of natural breeding places for this species are reported to be in riverside [11]. Seasonal wise diversity of mosquitoes recorded during the study period (Aug 2008- Jan 2009) (Table 3 and 4). During the winter season the more diversity was recorded in the study period December 2008 to January 2009 (**0.88**) and it was followed by the acute rainy season (**86**) and Moderate rainy season (**76**). The species diversity recorded from the study area was higher in acute rainy season with rich biodiversity index than the moderate and winter seasons. The biodiversity index was calculated for all the seasons. Occurrence of mosquitoes recorded from August 2008 to January 2009 in various sites of the study area showed that both the species richness and diversity index were higher in acute rainy season. Pattern of occurrence of mosquitoes of the study area also calculated. Among the ten species recorded *Culex quinquefasciatus* and *Culex pseudovishnui* was the only species exhibited moderate pattern of occurrence, five species with infrequent status where as the remaining three species were recorded as sporadic species (Table 5). The same result was reported, the pattern of occurrence of mosquitoes of the study area also calculated. Among the fourteen species recorded *Culex quinquefasciatus* was the only species exhibited constant pattern of occurrence, three species with infrequent status where as the remaining six species were recorded as sporadic species [12].

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